THE MAPPING OF NEW YORK STATE.

BY

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In the mapping of its area, the United States is far behind the countries of Europe. This condition of things is strange in view of the fact that the settlers of this country came from the most highly civilized countries of Europe, where the need of maps has long been recognized, and where maps have been used for generations in planning improvements which involve a knowledge of the surface of the ground. Moreover, these settlers came to a country where everything had to be done to render it habitable, where towns and cities were to be built, where waggon roads, railroads, canals, means of water supply and all other modern conveniences which make a country fit to live in were to be constructed. A partial explanation of this neglect may be found in the division of responsibility between the State and the general government, whereby each has waited for the other to undertake the work. It may moreover be found in the fact that the only plans proposed, until recently, for making such a map involved so enormous an expense and so long a time as to deter our law-makers from undertaking such a tremendous work. Be that as it may, the fact remains that until some fifteen years ago there were no maps of any considerable part of the country which were at all accurate or serviceable, if we except certain parts of the far West which had been mapped rather crudely by the general government.

It is true that maps upon small scales had been compiled from various sources; in certain States such maps had been compiled from the subdivisional surveys of the General Land Office, and in other States from private surveys of one sort and another; but these maps are upon too small a scale to aid in engineering works, and indeed many of them are mere diagrams of roads without any attempt at representing relief, or even drainage.

Meantime, however, much triangulation had been done in various parts of the country by the States and the general government, but, except along the coast and in New Jersey, this had not been followed by the making of maps. The skeleton had been constructed, but it had not been filled out with flesh and blood.

Such was the situation when, in 1882, the U. S. Geological Survey commenced its map of the country.

While this was the case with the country at large, New York, the most populous and wealthiest of all the States and in some parts the most densely settled, has been quite as backward as any other portion of the country. Prior to 1888 there were no maps of any part of the State which were worthy the name. The only map of the State in existence, known as the French map, was made by private parties, was compiled mainly from subdivisional surveys made a century ago, and from traverses of the roads and railroads. It is little more than a diagram of roads. This was published on a scale of 1:300,000, that is, about 4¾ miles to an inch, and practically represents all that was known of the State.

It was not from want of effort on the part of citizens or State officers that so little had been done. As long ago as 1827, Governor De Witt Clinton recommended the preparation of a map in a message to the Legislature, but the recommendation met with no response. Similar recommendations were made by Governors Hunt, in 1852, and Seymour, in 1853.

In 1875 the American Geographical Society became interested in the matter, and appointed a committee to study and report the condition of the maps of the State. Their report showed a very bad condition of things. It showed that the existing maps, made from these old land-parcelling surveys and by private parties, were as nearly worthless as possible, and recommended that the State commence a survey of its area. Largely as a result of this movement, the Legislature in 1876 passed a bill providing for a State survey, placing the work under a commission. Mr. James T. Gardner was appointed superintendent, and work was commenced in the following year. From that time until 1884, work was carried on continuously until it was stopped by the veto of Governor Cleveland in the year last named. During these eight years, primary triangulation only was done—no maps were made—and it was mainly on this ground that the work was stopped. The geodetic work of the U. S. Coast and Geodetic Survey in the valley of the Hudson River, and of the U. S. Lake Survey on the borders of the Great Lakes, furnished the base lines from which the State Survey extended triangulation into the interior. From the line Rafinesque-Helderberg of the U. S. Coast and Geodetic Survey, near Albany, triangulation was extended westward up the valley of the Mohawk as far as the western portion of Montgomery County. From the line Clyde-Victory of the U. S. Lake Survey, work was extended easterly and

thence southward to the Pennsylvania boundary. The work was carried on efficiently and economically, and was of a very high character, comparing favorably in quality with that of the U. S. Coast and Geodetic Survey and the U. S. Lake Survey. Altogether, 312 primary points and 400 subsidiary points were located, covering and controlling about one-fifth of the area of the State. The entire amount expended by the Survey during its existence was about $118,000.

The work was executed with eight- and twelve-inch theodolites reading by microscopes, and was adjusted by the method of least squares. The quality of the work may be characterized by the statement that the mean error of closure of 200 triangles was but 2.″02.

The U. S. Coast and Geodetic Survey, in the course of mapping the coast of the sea and navigable waters of the country, has extended a system of triangulation up the Hudson valley, across to Lake Champlain and along the shores of that lake. It has also extended a belt of triangulation from the neighborhood of Albany westward, connecting with the work of the U. S. Lake Survey near Buffalo. The high character of this work is too well known to need any commendation. The amount of map work executed by this organization is, however, limited. It has mapped Staten Island and the immediate shores of Long Island, the banks of the Hudson up to Albany, and the shore of Lake Champlain, the average width of the belt along the shore being but a fraction of a mile.

The U. S. Lake Survey has carried on triangulation in the neighborhood of Lakes Erie and Ontario and the St. Lawrence River, and has mapped their immediate shores, the strip of mapping being even narrower, on an average, than that of the U. S. Coast Survey. The character of the geodetic work of this organization is high.

For a number of years, from 1872 to 1884, there was carried on in the Adirondacks, partly at private and partly at State expense, a survey of that region, under Mr. Verplanck Colvin. Of this, very few results have been published. The positions of a few points, numerous elevations, and a few local sketch maps are, so far as the writer is aware, the only contributions which this Survey has made to a knowledge of the geography of the State. It is understood, however, that there is much matter collected by this organization awaiting publication.

With the exception of a few points determined by the U. S. Geological Survey, immediately for the control of its maps, the

above is a complete sketch of the triangulation executed in the State. This is represented upon a diagram of the State, Plate I, which shows that a large part of its area has been covered by primary triangulation.

This was the situation in the State when, in 1888, the U. S. Geological Survey commenced work there, in pursuance of its general plan of mapping the entire country. This plan contemplates the preparation of a map on scales of 1:62500 and 1:125000, or about one and two miles to an inch, the relief of the country being expressed by contour lines at intervals ranging from 5 to 100 feet. Under this plan somewhat more than one-fifth of the area of the country has been mapped.

The first work done in New York was in the vicinity of its metropolis, New York City, Brooklyn and their suburbs, and the result was the publication, shortly after, of four sheets, comprising the Greater New York. These four sheets, subsequently re-published in combined form, have been distributed by thousands. In subsequent years, the work was extended up the Hudson valley and into the Catskills.

Between 1888 and 1891 there had been mapped in New York by the U. S. Geological Survey 4,159 square miles. In 1892, the State Engineer, Mr. Martin Schenck, recommended to the Legislature that a small appropriation, $3,000, be made, for co-operation with the U. S. Geological Survey, in order to induce a more rapid prosecution of the work. This was agreed to, and the interests of the State in the joint work were confided to this officer. The result was that in that year the work was pushed much more rapidly, and aroused so much interest that in the succeeding year the appropriation was increased to $24,000, with $6,000 additional for determining county and township boundaries. Under this appropriation a formal agreement was entered into between the State Engineer, on the part of the State, and the Director of the U. S. Geological Survey, for the prosecution of the work, which agreement is here reproduced in full. It is a type of the agreements under which co-operation has been carried on by the U. S. Geological Survey to a successful conclusion with Massachusetts, Rhode Island and Connecticut:

AGREEMENT BETWEEN THE STATE ENGINEER OF NEW YORK AND THE DIRECTOR OF THE UNITED STATES GEOLOGICAL SURVEY FOR THE CONSTRUCTION OF A TOPOGRAPHIC MAP OF THE STATE OF NEW YORK.

(1) The preparation of this map shall be placed under the supervision of the Director of the United States Geological Survey, who shall determine the methods of survey and map construction.

(2) The order in which, in point of priority, different parts of the State shall be surveyed, shall be agreed upon in detail by the State Engineer and the Director of the United States Geological Survey.

(3) The work shall be based upon the triangulation of the U. S. Coast and Geodetic Survey, the U. S. Lake Survey and the New York State Survey, and wherever the triangulation is deficient it shall be supplemented by the U. S. Geological Survey.

(4) The survey shall be executed in a manner sufficiently elaborate to prepare a map upon a scale of 1:62500, exhibiting the hydrography, hypsography and public culture, and including all town and county boundary lines as established and marked by the State Engineer at the time of its completion, in form similar to the sheets already completed in this State. The preliminary field maps shall be on such a scale as the Director of the U. S. Geological Survey may select to secure accuracy in the construction of the final map.

(5) The hypsography shall be shown by contour lines with vertical intervals of 20 feet.

(6) The heights of important points shall be determined and furnished to the State Engineer.

(7) The outlines of wooded areas shall be represented upon proofs of the engraved map to be furnished the State Engineer.

(8) For convenience the Geological Survey shall, during the progress of the field work, pay the salaries of the persons employed therein, while the travelling, subsistence, and field expenses shall be paid for the same time by the State. For the office work on the map the salaries shall be divided between the two agreeing parties in such a way as to equalize expenses, provided that the total cost to the State of New York of the field and office work for the current year shall not be more than twenty-four thousand ($24,000) dollars.

(9) During the progress of the work free access to the field sheets and records of the topographers and draughtsmen shall be afforded the State Engineer for examination and criticism; and should the

State Engineer of New York deem that the work is not being executed in a satisfactory manner, then the said State Engineer may, on formal notice, terminate the agreement.

(10) The resulting map shall fully recognize the co-operation of the State of New York.

(11) When the work is completed the State Engineer shall be furnished by the U. S. Geological Survey with photographic copies of manuscript sheets; and when the engraving is completed and at all times thereafter when desired, the said State Engineer shall be furnished by the said Survey with the copper plates of the sheets of the map for use in printing editions of said maps."

Under this agreement, work was prosecuted very actively during 1893, and during 1894 until the State appropriation was exhausted, after which the U. S. Geological Survey continued work at its own expense, but on a more limited scale. In the latter year an attempt was made by the present State Engineer, Mr. C. W. Adams, to obtain an appropriation for continuing the work. This, however, was defeated, and in the place of it, a bill for reviving the old Adirondack Survey was passed, containing a provision for co-operation with the U. S. Geological Survey, but on a limited scale. This was so encumbered by objectionable features that it was vetoed by Governor Flower. The following clause from the Governor's veto message explains the reasons for his veto:

"The so-called Adirondack Survey began practically under Mr. Verplanck Colvin in 1872. It practically ended, though far from complete, in 1883, when Gov. Cleveland condemned it in strong words, and since that year no appropriation for the purpose has been granted, owing to the strenuous opposition to the character of the work and the manner of its carrying on. From 1872 till 1884 the cost of the Adirondack Survey alone amounted to upwards of $135,000, while only a very small percentage of the total work required to be done has been accomplished. While these surveys are very desirable, they should be placed in the most competent hands under the direction of the State Engineer, and they should be carried on as economically as possible. To revive the work which was quite properly discontinued by law in 1883, and for this purpose to create an independent new bureau outside the State Engineer's office, with a salaried superintendent at $5,000 a year and assistants, is unwise and extravagant legislation. If the State's experience with such a bureau in the past is any indication of what its experience would be in the future, the people should be spared so great an imposition.

By the passage of this bill the Legislature has also retarded the very excellent work on the State topographical survey which has been going on so successfully under the joint supervision of the State Engineer and the U. S. Geological Survey. Under the arrangement entered into between the United States and New York State authorities, the State was to pay half the expense of this work and the Federal government half, and up to date about a fifth of the area of the State has been sur-

veyed. This bill leaves the question of Federal co-operation substantially to the proposed superintendent of the State land survey, and while making the consent of the State Engineer contingent excludes him practically from participation in the work. A strict construction of the bill would also seem to make it optional with the superintendent whether he should set apart for the general survey $10,000 of the $30,000 appropriated, as is authorized in the bill."

The work done in the State up to the present date is represented upon the accompanying map, Plate II, and is summarized in the following statistics:

The total area surveyed is 10,000 square miles, or a trifle more than one-fifth its area. This work will be represented upon 57 atlas sheets, each covering 15′ of latitude and longitude, half of which have been already engraved and issued, and the remainder will be published within the next few months. These sheets are upon a scale of 1:62500, with a contour interval of 20 feet. The cost of the work, exclusive of engraving and printing the sheets, has been, on an average, and in round numbers, $10 per square mile.

The method of surveying employed in this work, although generally similar to that employed by other organizations, differs in certain details. It consists essentially in the location by one or another method of numerous points scattered over the area to be mapped, and then sketching the map with reference to these points. The work of making these locations constitutes the greater part of the operation, but these being mathematical points, do not appear as any part of the map itself, all of which is the result of the operation of sketching. The points selected for location are the summits of hills, the junctions of streams, houses, churches, road corners, etc. They are selected for location in such way as to control to the best possible advantage the contour lines, the streams, roads and other objects which are to be sketched.

Each sheet of the map is surveyed separately. Upon each sheet are located by primary triangulation two or more points as initial points. In some cases these are furnished by pre-existing triangulation; in other cases the U. S. Geological Survey has been obliged to make its own locations, and for doing this primary work, eight-inch theodolites, reading by microscope to 2 seconds, are used. These primary positions furnish a basis for plane-table work, and the work from that point on is relegated to that instrument.

The plane-table is a universal instrument for making maps, applicable to all scales, all methods and all kinds of country. Of all instruments it is the most simple and direct, and, other things equal, produces the most satisfactory results, since with it the map

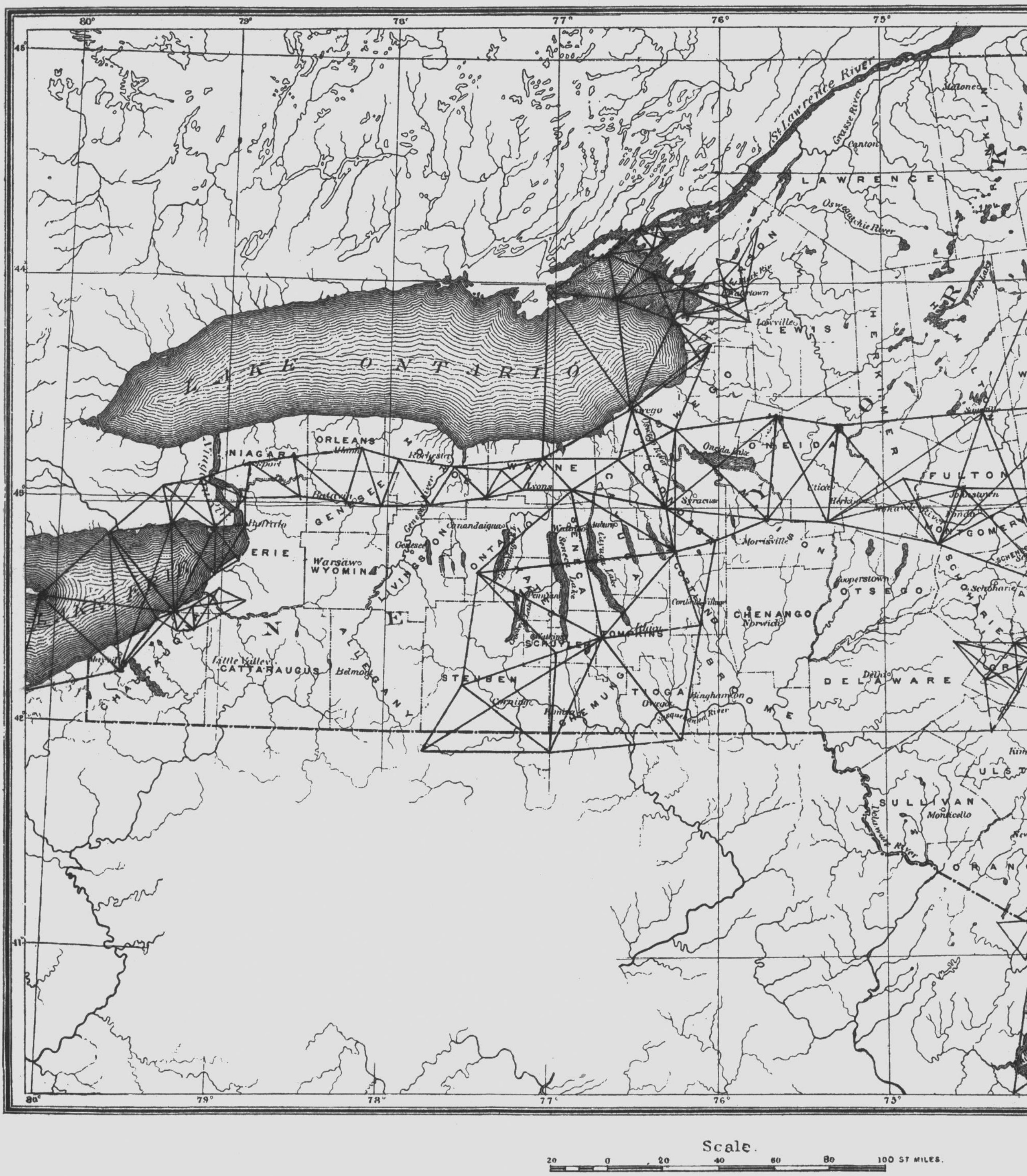
is made directly upon the ground with the country before the topographer as copy.

It consists essentially of a board of convenient size, mounted on a tripod in such wise that it may be levelled, turned horizontally and clamped in any position. To this board is attached a sheet of paper upon which the map is made. A projection is drawn upon this sheet and the primary points are located thereupon. Another essential feature of the instrument is the alidade, which consists of a metal ruler to which is attached a telescope, or, in the cruder forms, a pair of sights.

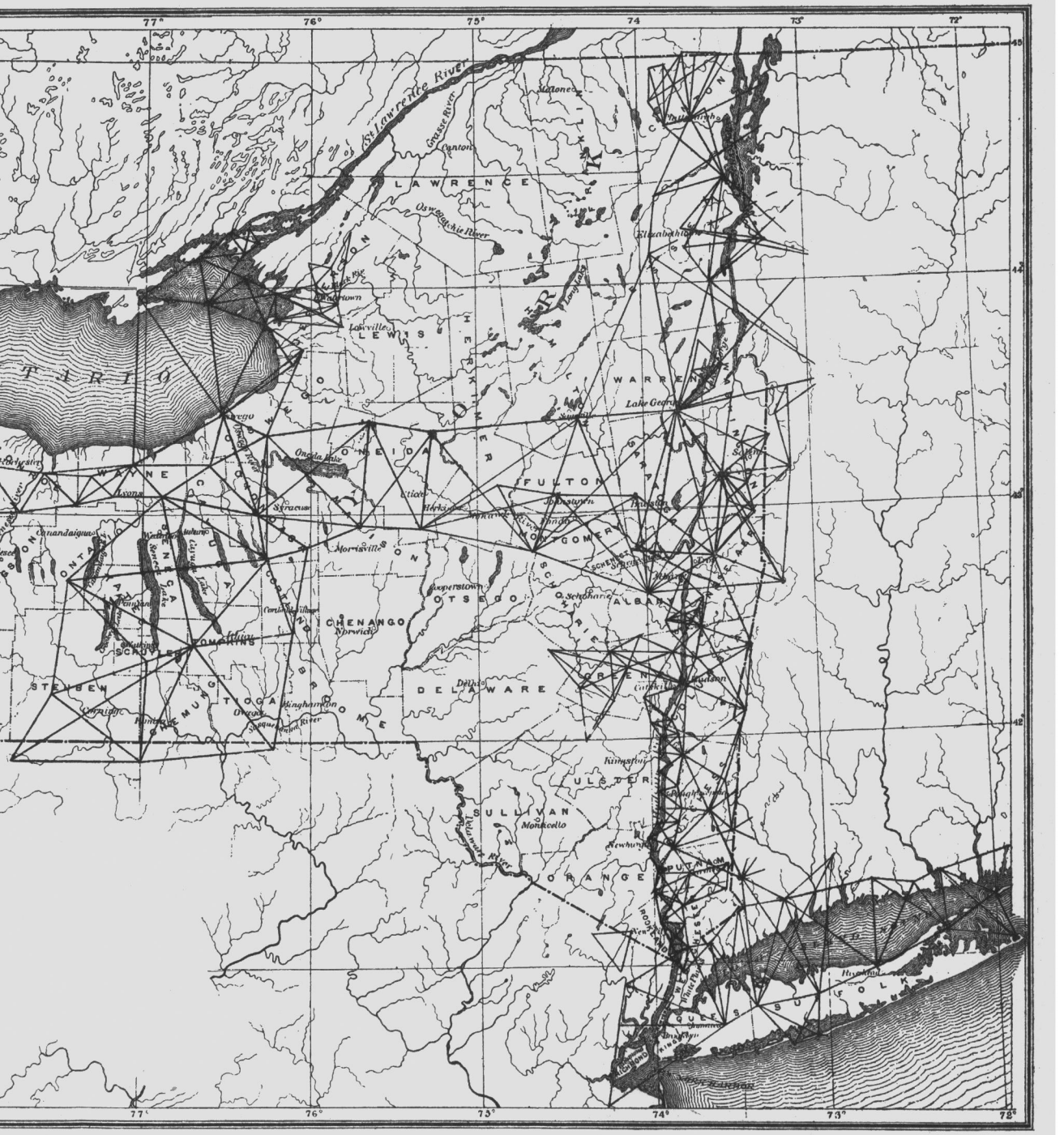
To commence the work with the plane-table, the instrument is set up over one of the primary positions in the area to be mapped and levelled. The ruler of the alidade is laid along the line connecting this station with another primary point. Without moving the alidade, the whole table is then turned horizontally until the telescope points upon the other station. The table is then in its proper position, or, technically speaking, it is "oriented," and is then clamped in this position. Then keeping the ruler upon the point on the paper representing the station occupied, sights are taken and lines drawn to all points in view, which it is desired to locate. The table is then moved to another primary station, is oriented by pointing upon the first station, and lines are drawn to the points sighted from the first. The points of intersection of these lines are the locations of the points sighted. Any of these points may be occupied as stations in a similar manner, and lines drawn to other points, thus locating them. Thus the sheet is covered with locations, and the positions of all points desired are fixed.

There is another method of making locations which is used extensively in mapping roads, streams and other linear features. In this, instead of locating points by the intersection of two lines or triangulation, location is made by measuring the direction and distance. The directions are measured with a plane-table, using commonly a cruder instrument than that employed in triangulation, and the distances are commonly measured by counting the revolutions of a wheel, although sometimes the telemeter is used.

Heights for the location of contour lines are measured by a variety of means dependent upon the accuracy with which they are desired. Primary heights are measured by the use of the Wye level, by which profiles are run across the sheet. From points in these profiles, vertical angles are taken to many points, and their heights determined thereby, while the heights of minor details are



LAKE ONTARIO
ERIE
St. Lawrence River
LAWRENCE
Malone
Canton
Oswegatchie River
Watertown
Lowville
LEWIS
HERKIMER
ONEIDA
Oneida Lake
FULTON
MONTGOMERY
NIAGARA
ORLEANS
WAYNE
GENESEE
Batavia
Buffalo
Canandaigua
Geneseo
Warsaw
WYOMING
LIVINGSTON
ONTARIO
SENECA
CAYUGA
Auburn
Syracuse
Utica
Morrisville
MADISON
CORTLAND
CHENANGO
Norwich
Cooperstown
OTSEGO
SCHOHARIE
DELAWARE
Delhi
ALLEGANY
CATTARAUGUS
Little Valley
Belmont
STEUBEN
Corning
CHEMUNG
TIOGA
Binghamton
Owego
BROOME
TOMPKINS
Ithaca
SCHUYLER
YATES
SULLIVAN
Monticello
Delaware River
Susquehanna River
Scale.
20 0 20 40 60 80 100 ST. MILES.



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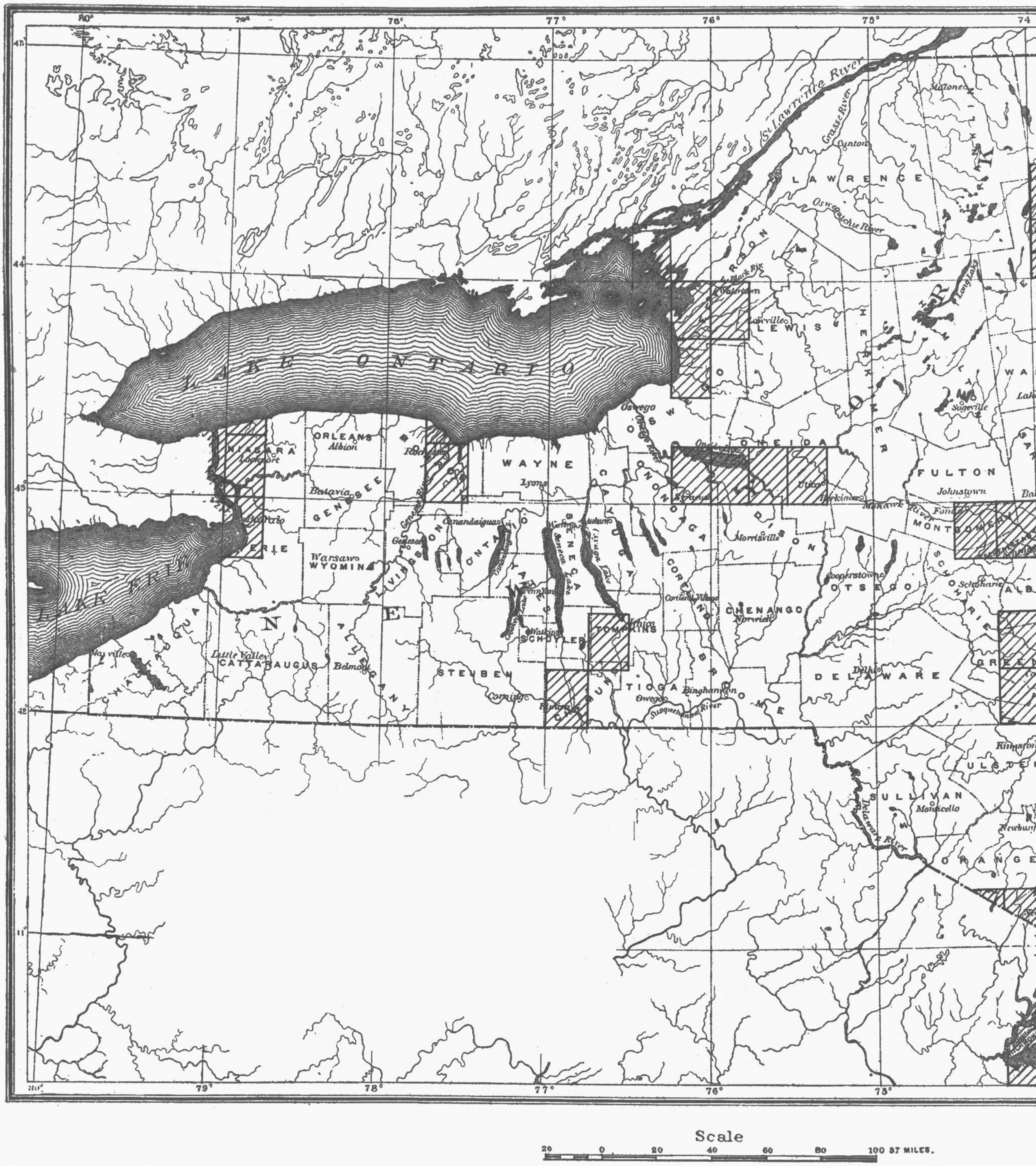
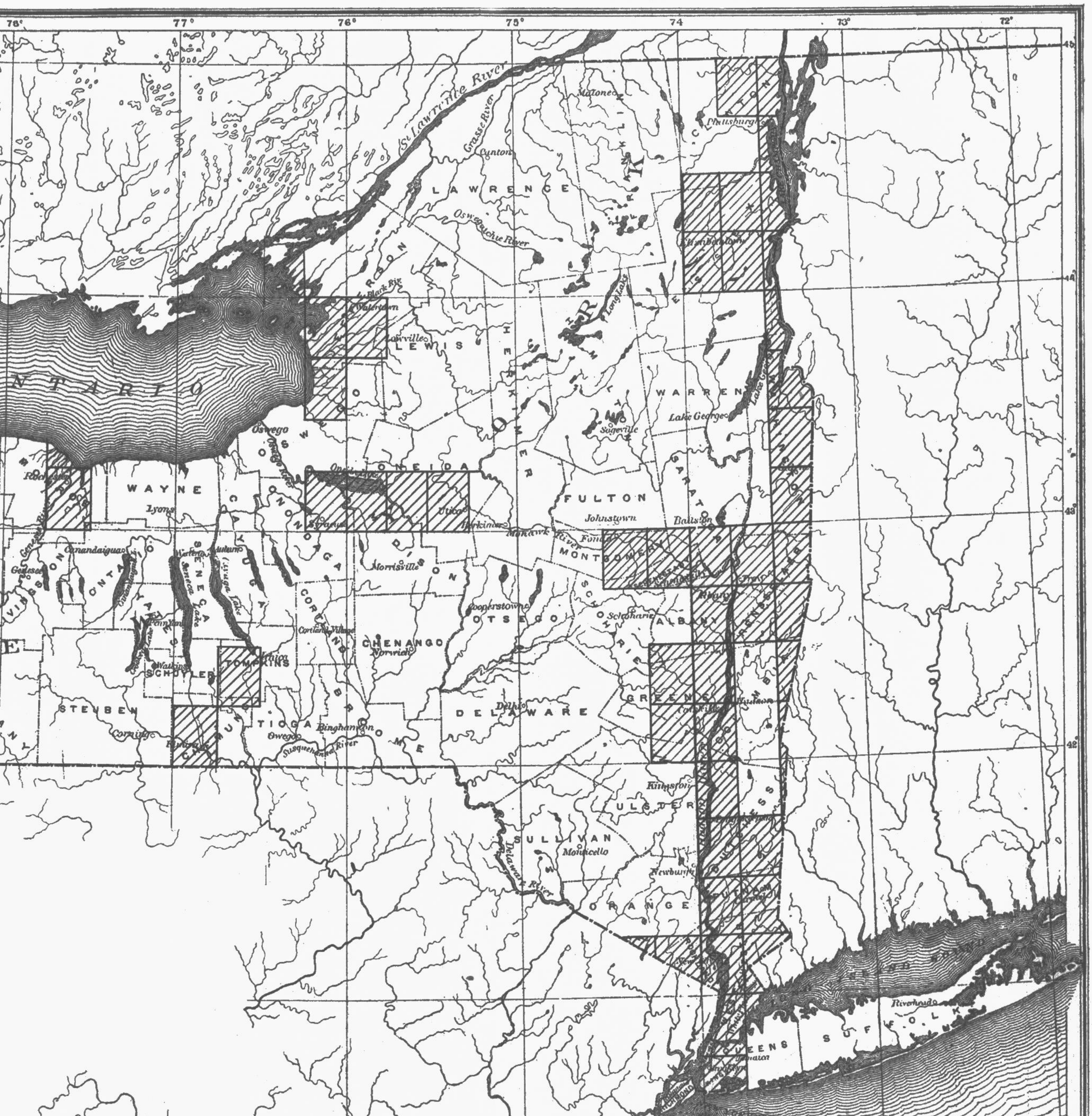

LAKE ONTARIO
LAKE ERIE
St Lawrence River
Grasse River
Oswegatchie River
LAWRENCE
LEWIS
HERKIMER
FULTON
Johnstown
MONTGOMERY
Mohawk River
ONEIDA
Utica
Herkimer
ONONDAGA
Oswego
OSWEGO
WAYNE
Lyons
ORLEANS
Albion
NIAGARA
Lockport
GENESEE
Batavia
ERIE
WYOMING
Warsaw
LIVINGSTON
Geneseo
ONTARIO
Canandaigua
SENECA
CAYUGA
Auburn
Cayuga Lake
Seneca Lake
CORTLAND
Cortland Village
CHENANGO
Norwich
MADISON
Morrisville
OTSEGO
Cooperstowne
SCHOHARIE
Schoharie
DELAWARE
Delhi
TOMPKINS
Ithaca
SCHUYLER
Watkins
YATES
Penn Yan
STEUBEN
Corning
TIOGA
Owego
Binghamton
BROOME
Susquehanna River
CATTARAUGUS
Little Valley
ALLEGANY
Belmont
CHAUTAUQUA
SULLIVAN
Monticello
Delaware River
ORANGE
ULSTER
Kingston
GREENE
Scale
20 0 20 40 60 80 100 ST MILES.



78°
77°
76°
75°
74°
73°
72°
St Lawrence River
Grasse River
Oswegatchie River
LAWRENCE
Canton
Malone
Plattsburgh
Elizabethtown
Watertown
Lowville
LEWIS
WARREN
Lake George
Sageville
Oswego
WAYNE
Lyons
ONEIDA
Utica
Herkimer
Mohawk River
FULTON
Johnstown
Ballston
MONTGOMERY
Canandaigua
Geneseo
Morrisville
Cooperstown
OTSEGO
Schoharie
ALBANY
Cortland Village
CHENANGO
Norwich
TOMPKINS
Ithaca
SCHUYLER
Watkins
STEUBEN
Corning
TIOGA
Owego
Binghamton
Susquehanna River
Delhi
DELAWARE
Kingston
ULSTER
SULLIVAN
Monticello
Delaware River
Newburgh
ORANGE
Riverhead
SUFFOLK
Scale
20
0
20
40
60
80
100 ST MILES.

measured by the use of the aneroid, checking it frequently upon known elevations.

When the locations and height measurements upon a sheet have been completed, all these data are assembled upon one sheet, and then taken in hand by the most experienced sketcher in the party, usually its chief, who goes over the sheet, occupying all points which seem desirable, and sketches the natural and artificial features, referring them for position, size and shape to these located points and height measurements. Since the positions are scattered over the sheet, usually with a dozen or more on each square inch, there is little room for error in the sketching.

As is shown by a glance at the map representing the progress of topographic work, the regions already surveyed comprise most of the Hudson valley, and part of that of the Mohawk, portions of the lake region, the surroundings of Niagara Falls, Buffalo and Rochester, the neighborhood of Watertown, the shores of Lake Champlain and part of the high mountain regions of the Adirondacks and the Catskills.

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